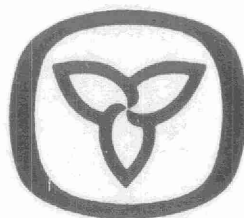


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SPOT SURVEY OF WATER QUALITY

IN THE

MIDDLE MAITLAND RIVER

IN THE

VICINITY OF LISTOWEL

September 1971 and May 1972

by

D.S. Osmond

Biology Section

June 1972

B.S. 5.3 SPOT SURVEY OF WATER QUALITY IN THE
MIDDLE MAITLAND RIVER IN THE VICINITY OF
LISTOWEL - SEPT. '71 - MAY '72 - D.S. OSMOND - JUN. '72

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ONTARIO

M.O.E.

Spot Survey of Water Quality
in the Middle Maitalnd River
in the Vicinity of Listowel
June 1972

Tel. 965-6141

MEMORANDUM

September 7, 1972

TO: Mr. D.S. Caverly,
Assistant Deputy Minister

FROM: John H. Neil, Director,
Water Quality Branch

RE: MIDDLE MAITLAND RIVER REPORT

Enclosed is a copy of a report dealing with a comparison of biological conditions in the Middle Maitland River in September of 1971 and May of 1972, which is related to requirements for waste treatment at Listowel.

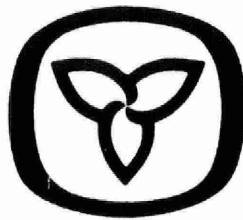
In view of some problems which have developed recently in the operation of a total retention-spray irrigation system at Listowel, the need for further documentation of stream conditions, and public sensitivity towards the continuing question of what pollution control facilities should be implemented, it has been decided that this report should be restricted to internal distribution. Additional evaluations are currently being undertaken by personnel of the Water Quality Branch to gain further knowledge of river quality under late summer conditions, with the spray irrigation system in operation, which should provide an improved basis for appraising the relative suitability of waste treatment alternatives.

JHN/as

.....
John H. Neil

encl.

c.c. Messrs. K.H. Sharpe; A.K. Watt;
J.R. Barr; J.M. Timko;
J.R. Bray; E.E. Salbach;
D.A. McTavish; D. Osmond



Environment Ontario

SPOT SURVEY OF WATER QUALITY

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SUMMARY

Spot surveys of the Middle Maitland River near Listowel were conducted in September 1971 and May 1972 following prolonged exposure of the river to two differing methods of municipal and industrial waste treatment. From May to November 1971, wastes from Listowel were treated by a total retention - spray irrigation system while from November 1971 until May 1972, wastes were discharged to a sewage stabilization pond system from which effluent was released to the river on a periodic basis. Biological and chemical parameters were investigated and physical observations documented.

In general, biological and chemical data indicated that the quality of the river in 1971 exceeded that in 1972 with the exception of a reference sampling site on Boyle Drain where quality improved noticeably in 1972.

Although some indication of organic enrichment was evident in the Middle Maitland River both immediately below Listowel and downstream of the Chapman Drain, especially-enriched conditions were obvious about 2 miles downstream at Trowbridge during both years. Bottom fauna data indicated that conditions were worse in 1972 than in 1971.

Biological data for both years demonstrated that marked recovery occurred some 10 to 15 miles below the Chapman Drain, near Ethel. However, on May 15, 1972, water in this area was coloured dark green by phytoplankton and exhibited higher-than-normal concentrations of BOD, indicative of a waste slug from the Listowel lagoons. On the same day, water in the Chapman Drain to which the lagoons discharge was aesthetically unsuitable and strongly malodorous.

(ii)

Even under the higher flow conditions of late spring, diurnal concentrations of dissolved oxygen in 1972 fell below 5 ppm at sampling sites immediately upstream and downstream of the Chapman Drain. At Trowbridge, levels of dissolved oxygen attained a peak of 20 ppm during daytime and fell to a low of 2 ppm for a period of at least four hours overnight.

On the basis of these two biological surveys of the Middle Maitland River, it is evident that lagoon treatment followed by spray irrigation affords better protection to the aquatic environment than the current discharge of lagoon effluent to the river during periods of high flow.

Spot Survey of Water Quality in the Middle
Maitland River in the Vicinity of Listowel
(September 1971 & May 1972)

INTRODUCTION

To better define water quality of the Middle Maitland River in the Listowel area, staff of the Water Quality Branch and the Sanitary Engineering Branch of the Ministry of the Environment conducted studies during the summer of 1971 and the spring of 1972. The results of one of the 1971 studies have been reported in "Middle Maitland River Water Quality Survey, July 1971" (OWRC, 1971). Briefly, the report concluded that wastes from agricultural and municipal sources were gaining access to the Middle Maitland River and that concentrations of nutrients were adequate to support excessive growth of aquatic vegetation

This report summarizes findings of brief biological surveys conducted in late September 1971 and early May 1972 coincident with two differing approaches to municipal waste treatment at Listowel.

WASTE TREATMENT - LISTOWEL

Sanitary sewers currently service about 75 percent of Listowel - a town with an approximate population of 4,600 people. Municipal wastes, along with wastes from a chicken processing plant operated by the Campbells Soup Co. Ltd., are directed to two waste stabilization ponds totalling 70 acres in surface area.

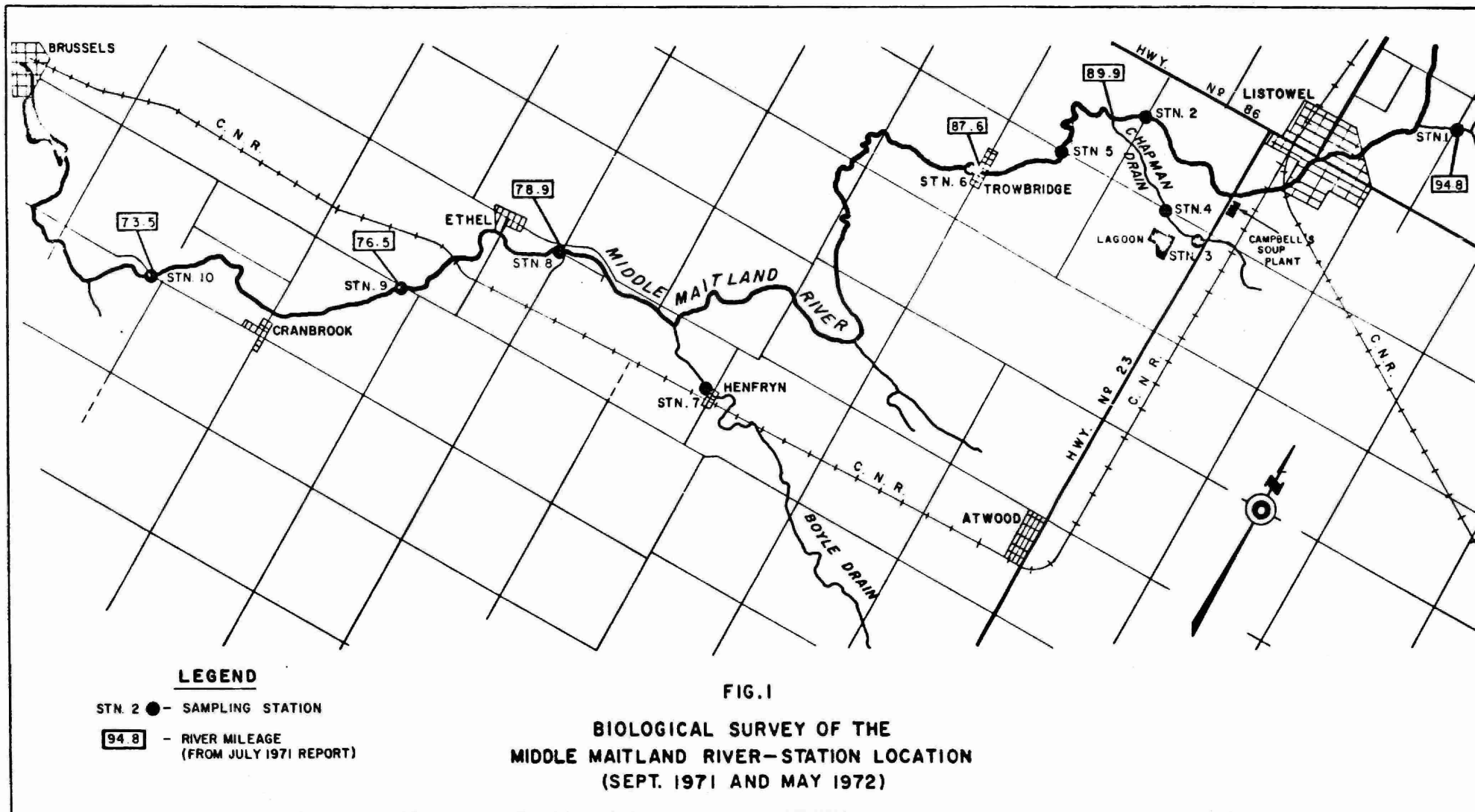
A third one-acre primary aeration cell containing two mechanical aerators began preliminary operation in August, 1971. Discharge of wastes from the lagoons was curtailed from mid-May until November 1971 while development of the primary aeration system advanced. From September to November of this period, about 1 million gallons per day were spray-irrigated from the final cell to adjacent farmland. Lagoon contents were subsequently discharged to the river from November until May, 1972 via the Chapman Drain.

Wastes from unserviced portions of the town gain access to the river upstream of the point of entry of the Chapman Drain.

METHODS

From September 24 to October 5, 1971 and on May 15, 1972, aquatic organisms associated with the river bottom were sampled at eight locations (Figure 1) on the Middle Maitland River from Listowel to Brussels. Bottom fauna collections were made using a hand sieve employing a consistent sampling time of ten minutes at each site. Samples were preserved and returned to the London laboratory for identification and enumeration. Observations such as colour and odour of the water and occurrence of aquatic vegetation were recorded along with other pertinent information.

Water samples for chemical analysis were collected only on the May 15, 1972 survey. However, results of pertinent chemical analyses of water samples collected in 1971 at four sites in the study area in conjunction with the Ministry's water quality monitoring program were assembled for consideration in this report. On May 28 and 29, 1972 concentrations of dissolved oxygen were determined at four-hour intervals over a 24-hour period at seven of the stations.



RESULTS

It must be stressed that all 1972 results are typical of spring conditions when flows are optimal. Water quality on the Middle Maitland River below Listowel may be expected to further deteriorate this summer as flows decrease and weed growth increases.

Bottom Fauna

A list of numbers and types of organisms collected in 1971 and 1972 is presented in Table 1 of the Appendix and the results are illustrated graphically in Figure 2.

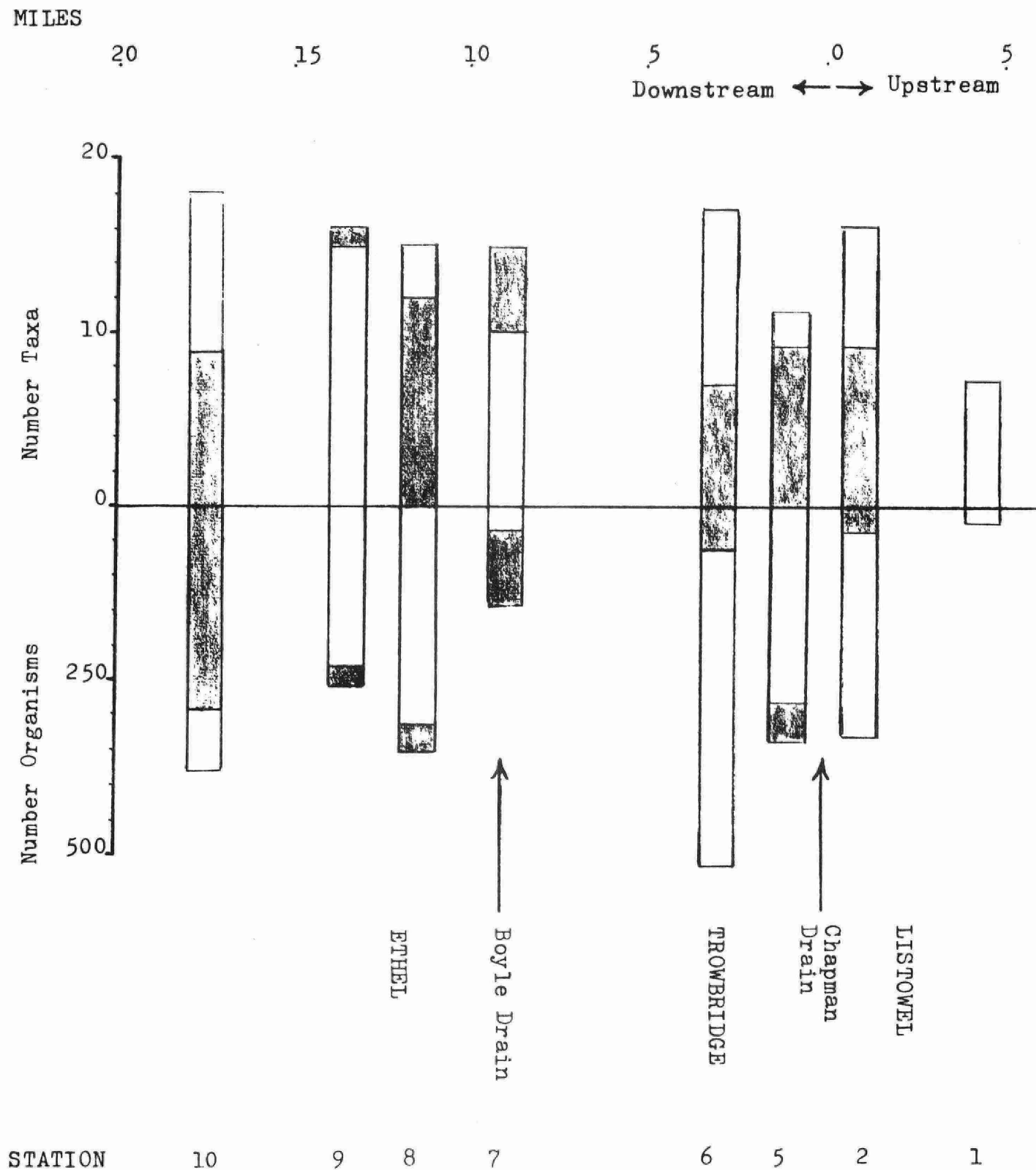
A total of 31 taxa were collected from 7 sampling sites in 1971 while 27 were found at 8 stations in 1972. Averages of 14.6 taxa and about 300 organisms per station were obtained in 1971 followed by a reduction to 11 taxa and 200 organisms per station in 1972.

At station 1 upstream of Listowel inadequate flow was present in 1971 for a representative sample. Although types and numbers of organisms collected at this station in 1972 were limited probably as a result of intermittent flow conditions, those present (caddisfly larvae, crayfish, unionid clams) were typical of unimpaired water quality.

Upstream of the Chapman Drain but below Listowel at station 2, variety and numbers of organisms were greatly reduced in 1972 and pollution-intolerant mayflies (Caenis, Callibaetis) present in 1971 were absent in 1972. In both years, the river bottom appeared highly organic in composition and supported a 60-80% cover of aquatic vegetation.

In both 1971 and 1972, the benthic associations at station 5 below the Chapman Drain were similar both qualitatively

Figure 2: Numbers and types of benthic macroinvertebrates collected at eight stations on the Middle Maitland River (Sept. '71, May '72).



1972 { 1971

(11 and 9 taxa respectively) and quantitatively (284 and 342 organisms respectively). Facultative detritus-feeders (Hyallolela azteca) and tolerant worms and leeches were common and mayflies were found only occasionally. Compared to upstream station 2, the number of taxa decreased from 16 to 11 in 1971 but remained the same in 1972 (9 taxa). A slight odour was present both years and heavy weed growths and algal scums covered the heavily silted bottom. Fish were observed in 1971.

Greatest enrichment in 1971 and most obvious impairment in 1972 was indicated by benthic macroinvertebrates at station 6 (Trowbridge). Although the presence of a total of 11 taxa in 1971 including one species of mayfly and 3 snail genera was indicative of somewhat improved quality over upstream station 5, this qualitative improvement was offset by a major increase in numbers of organisms to 515. This association, typical of enriched conditions, was dominated by detritus-feeding Hyallolela azteca, tolerant sludgeworms (Tubificidae) and leeches. In 1972, only seven facultative or tolerant taxa were found at this station comprising a limited sample of 67 organisms. Water was clear both years but weed and algae growth completely covered the black organic sediments which were indicative of anaerobic conditions. No fish were observed.

The benthic association at reference station 7 on the Boyle Drain below Henfryn showed improvement in 1972 over 1971 conditions. Numbers of taxa increased from 10 to 15 and the 1972 population included 2 species of mayfly, caddisfly larvae, crayfish and 4 snail species. Water was clear both years at this location and many minnows were always present.

At stations 8 and 9 the presence of less-tolerant forms (mayflies, caddisflies, clams and a variety of snails) and decreasing numbers of organisms with progress downstream, indicated noticeable improvement both in 1971 and 1972.

Several fish species were present. Even with this improvement in the benthic community and the apparent occurrence of a resident fish population the persistence of heavy weed growths provided evidence of excessive nutrient enrichment. A significant reduction in variety at station 10 was evident in 1972. Water at stations 8, 9 and 10 was very green in 1972 and visibility at station 9 through this algae-laden water was only 3 inches.

Chemical Quality

Results of routine water quality monitoring during 1971 at four stations in the study area are indicated in Table 1 while results of chemical analyses conducted on samples collected on May 15, 1972 are presented in Table 2.

In 1971, it can be seen from average results that concentrations of most parameters increase with progress downstream to Trowbridge with a reversal in this trend by Brussels. Total and soluble phosphorus concentrations increased markedly below Listowel although only slight (if any) increases were evident in average concentrations of BOD, suspended solids, organic and inorganic nitrogen between stations upstream and downstream of Listowel. Downstream of the Chapman Drain at Trowbridge, major increases in all parameters were evident. Recovery to conditions similar to those below Listowel but above the Chapman Drain occurred at Brussels.

During the May 15, 1972 sampling run, concentrations of most parameters above Listowel and above the lagoons on Chapman Drain were similarly low. Slight increases over reference conditions in concentrations of total and soluble phosphorus were found below Listowel but above the Chapman Drain. In the Drain below the lagoons, concentrations of most parameters increased at the minimum twenty-fold. The water was greenish in colour

Table 1:

Results of chemical analysis on
samples collected at 4 stations on the Middle
Maitland River as part of the Water Quality
Monitoring Program 1971. (Results in mg/l)

Location	No. Samples	B.O.D.	Susp. Solids	Kjel.	Total Inorg. Nitrogen as N	Phosphorus Tot. Sol.
Upstream						
Listowel						
MM 99.3						
16/8/71-						
28/12/71	9	1.6	6	0.86	2.02	0.09 0.01
Hwy. 23						
MM 91.4						
16/8/71 -						
28/12/71	9	2.1	7	0.78	1.00	0.30 0.12
Trowbridge						
MM 87.6						
4/1/71-						
28/12/71	22	6.3	24	2.26	2.29	0.63 0.34
Brussels						
Below Creamery						
MM 69.1						
4/1/71 -						
28/12/71	22	2.1	8	1.07	1.90	0.17 0.09

Table 2: Results of chemical analyses of water samples collected from the Middle Maitland River near Listowel on May 15, 1972.
(All results but pH and turbidity in mg/l)

Location	BOD	Susp. Solids	Kjel.	Inorganic Nitrogen as N	Phosphorus Tot. ^{as P} Sol.	Turbidity	pH
1. Above Listowel	1.6	5	0.67	0.692	0.033 0.006	6	8.0
2. Above Chapman Drain	2.6	15	0.57	0.458	0.060 0.027	1.5	8.4
3. Chapman Drain above lagoons	1.0	10	0.51	0.124	0.020 0.006	4	7.7
4. Chapman Drain below lagoons	55	110	13	4.215	2.9 1.4	70	8.9
5. Maitland River	2.6	5	0.73	0.454	0.10 0.067	4	8.6
6. At Trowbridge	3.8	50	0.97	0.416	0.13 .078	12	8.6
7. Boyle drain	2.4	5	0.79	0.630	0.028 0.017	4	8.0
8. Above Ethel	7.0	10	1.3	0.530	0.13 0.012	8	8.4
9. Below Ethel	12	20	1.9	0.338	0.16 0.010	30	8.6
10. Above Brussels	12	30	1.8	0.179	0.16 0.008	20	8.5

L = Less Than

and emanated a strong nauseating odour. Between the Chapman and Boyle Drains chemical water quality in the river did not appear seriously impaired although nutrient concentrations were well above levels at reference sites (stations 1, 3 and 7). Chemical results, water colour and odour indicated that a slug of wastes typical of a lagoon discharge extended from Ethel to Brussels at the time of sampling.

Dissolved Oxygen

Results of the 24-hour dissolved oxygen run are presented in Table 3 and diurnal curves at the seven stations are illustrated graphically in Figure 3.

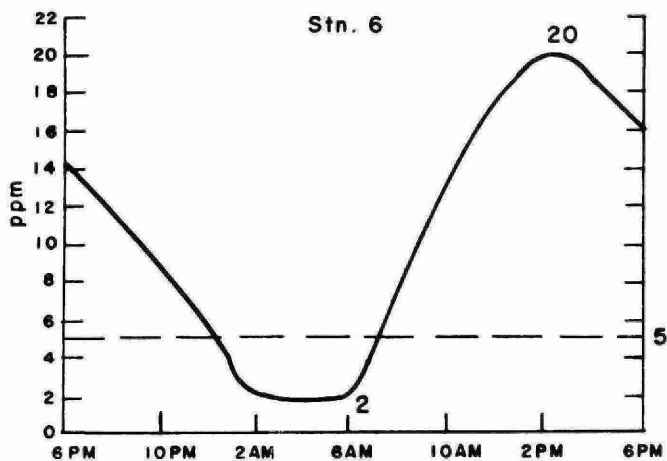
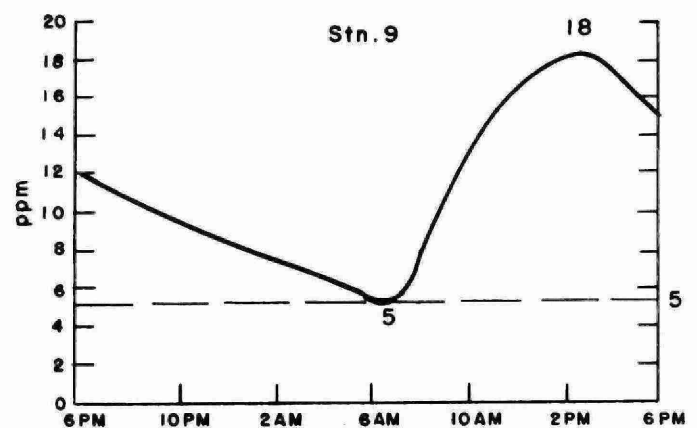
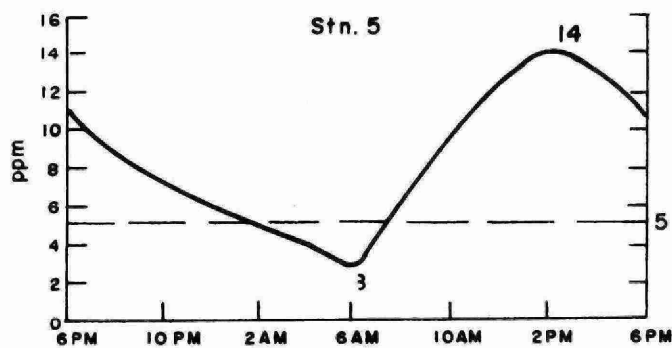
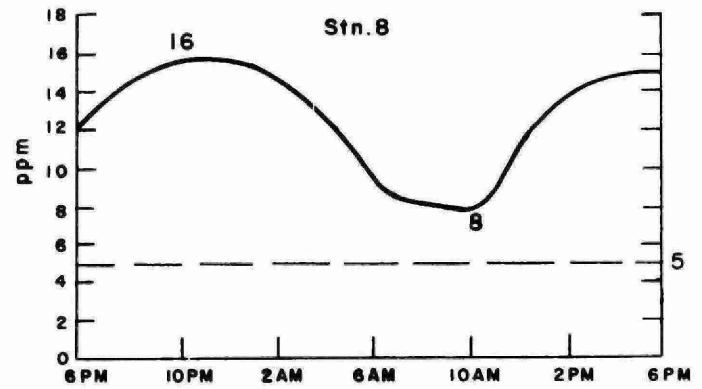
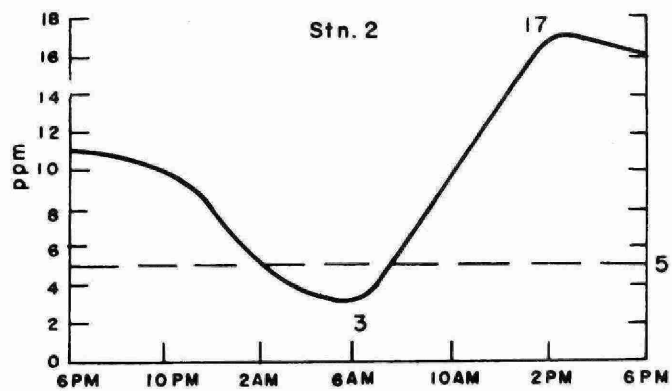
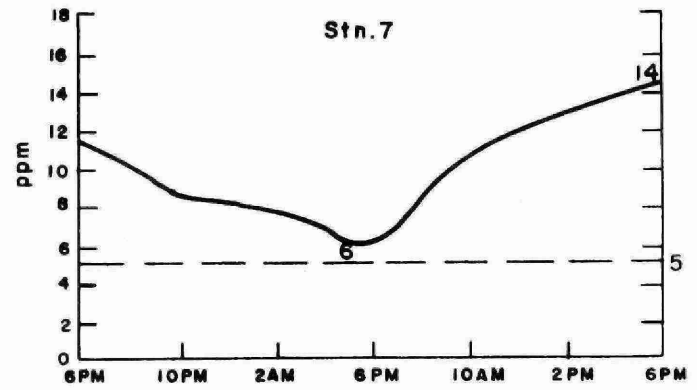
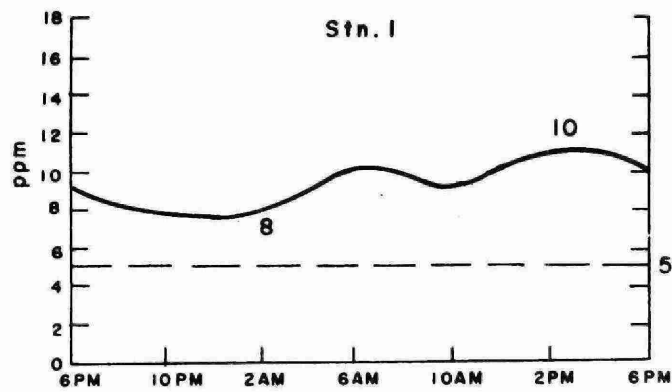
Ranges in diurnal levels of dissolved oxygen provide a good indication of relative abundance of aquatic vegetation between stations and thus illustrates areas of greatest enrichment in the study stream. The significance of dissolved oxygen to warm-water biota is reflected in "Guidelines and Criteria for Water Quality Management in Ontario" (OWRC, 1970) which states that the dissolved oxygen concentration should be above 5 ppm at all times.

At reference stations upstream of Listowel and on Boyle Drain, concentrations of dissolved oxygen ranged between 8 and 11 ppm and 6 and 13 ppm respectively. Below Listowel at station 2, concentrations ranged between 3 and 17 ppm with levels at or below 5 ppm for at least four hours of the day providing an indication of significant enrichment. A similar situation occurred at station 5 below the Chapman Drain. At station 6 at Trowbridge, concentrations of dissolved oxygen fell to a critical low of only 2 ppm for at least four hours of darkness and climbed to 20 ppm at 2 o'clock the next afternoon. The oxygen regime at station 8 was variable but never fell below 8 ppm while the range between maximum and minimum levels at station 9 increased and dropped to 5 ppm at 6 a.m.

Table 3 - Concentration (ppm) and percent saturation of dissolved oxygen at seven sites on the Middle Maitland River over a 24-hour period (May28 & 29, 1972.)

	Dissolved Oxygen (ppm) and Percent Saturation							
STATION	6:00 p.m.	10:00 p.m.	2:00 a.m.	6:00 a.m.	10:00 a.m.	2:00 p.m.	6:00 p.m.	
1	9.5 (115%)	8.0 (90%)	8.0 (86%)	10.0 (99%)	9.0 (95%)	11.0 (131%)	10.0 (124%)	
2	13.0 (160%)	10.0 (118%)	5.0 (55%)	3.0 (32%)	10.0 (110%)	17.0 (213%)	16.0 (204%)	
5	11.0 (134%)	7.0 (82%)	5.0 (54%)	3.0 (32%)	10.0 (110%)	14.0 (173%)	11.0 (135%)	
6	14.5 (175%)	9.0 (105%)	2.0 (21%)	2.0 (21%)	14.0 (156%)	20.0 (251%)	16.0 (204%)	
7	12.0 (143%)	9.0 (105%)	8.0 (88%)	6.0 (65%)	11.0 (124%)	13.0 (157%)	14.0 (176%)	
8	13.0 (148%)	16.0 (184%)	15.0 (173%)	9.0 (99%)	8.0 (90%)	14.0 (163%)	15.0 (175%)	
9	12.0 (140%)	9.0 (104%)	7.0 (77%)	5.0 (54%)	14.0 (163%)	18.0 (225%)	14.0 (173%)	

FIGURE 3 : DIURNAL OXYGEN CURVES AT 7 LOCATIONS
ON THE MIDDLE MAITLAND RIVER (MAY 28 - 29, 1972)



APPENDIX

Table 1: Macroinvertebrates collected at
eight stations on the Middle Maitland
River (September 1971 and May 1972).

Table I: Macroinvertebrates collected at 8 stations on the Middle Maitland River (September 1971 and May 1972)

ORGANISM	S T A T I O N															
	1		2		5		6		7		8		9		10	
	71	72	71	72	71	72	71	72	71	72	71	72	71	72	71	72
MAYFLIES																
<u>Caenis</u>			10			4					5		1	2	2	
<u>Callibaetis</u>			2		2		7						2	1		
<u>Ephemerella</u>																
<u>Stenonema</u> spp.											8		1	9	1	5
<u>S. tripunctatum</u>										4					1	11
CADDISFLIES	10			1							6	29		4	8	6
DRAGONFLIES	1	5	4	5	5	5	4	3	2		1	3			1	7
DAMSELFLIES	1	151	15	80	40	90			11	81	4	6	42	12	40	18
BEETLES																
Elmidae							3								1	
Hydrophilidae			1													8
Pspheniidae																4
unident. adults	5		6	1	15	5	4	3	10	3	1	5	24			2
DIPTERA																
Chironomidae			9			5	10				14	6	16		42	
Simuliidae			4				2					1				8
unident.					1		1		1				1			
BUGS																
Corixidae			17		14		4		3							
GRAYFISH																
	3										1	1	2			

Table I continued

	1		2		5		6		7		8		9		10	
	71	72	71	72	71	72	71	72	71	72	71	72	71	72	71	72
AMPHIPODS																
<u>Hyallela azteca</u>			68	6	159	248	280	48	5	10	10		42	48	100	199
CIAMS																
<u>Sphaerium</u>								4	5		63	19	1	2	1	
<u>Pisidium</u>			19								2				2	
Unionidae	1														1	
SNAILS																
<u>Amnicola</u>										1	108	256	48	90	44	34
<u>Gyraulus</u>							1			2			1	1	1	
<u>Helisoma</u>			3	1			1		1							
<u>Lymnaea</u>														1		2
<u>Physa</u>									2	2	9	14	7	8	18	6
<u>Valvata</u>			2		2		12		1	1	62	30	41	15	106	2
MITES																
										1						
FLATWORMS																
											3		19	1	9	
LEECH																
<u>Helobdella</u>			16	1	2	1	10						1		1	
Sp. A	2															
Sp. B			11	2	1		20	2								
Sp. C			16	8	17	16	9	4								
WORMS																
Tubificidae			1			8	55	2		1						
NO. TAXA	7	16	9	11	9	17	7	10	15	15	12	15	16	18	9	
NO. ORGANISMS	23	335	44	284	342	515	67	34	147	310	351	224	257	380	287	